Science with multi-wavelength Archival Data

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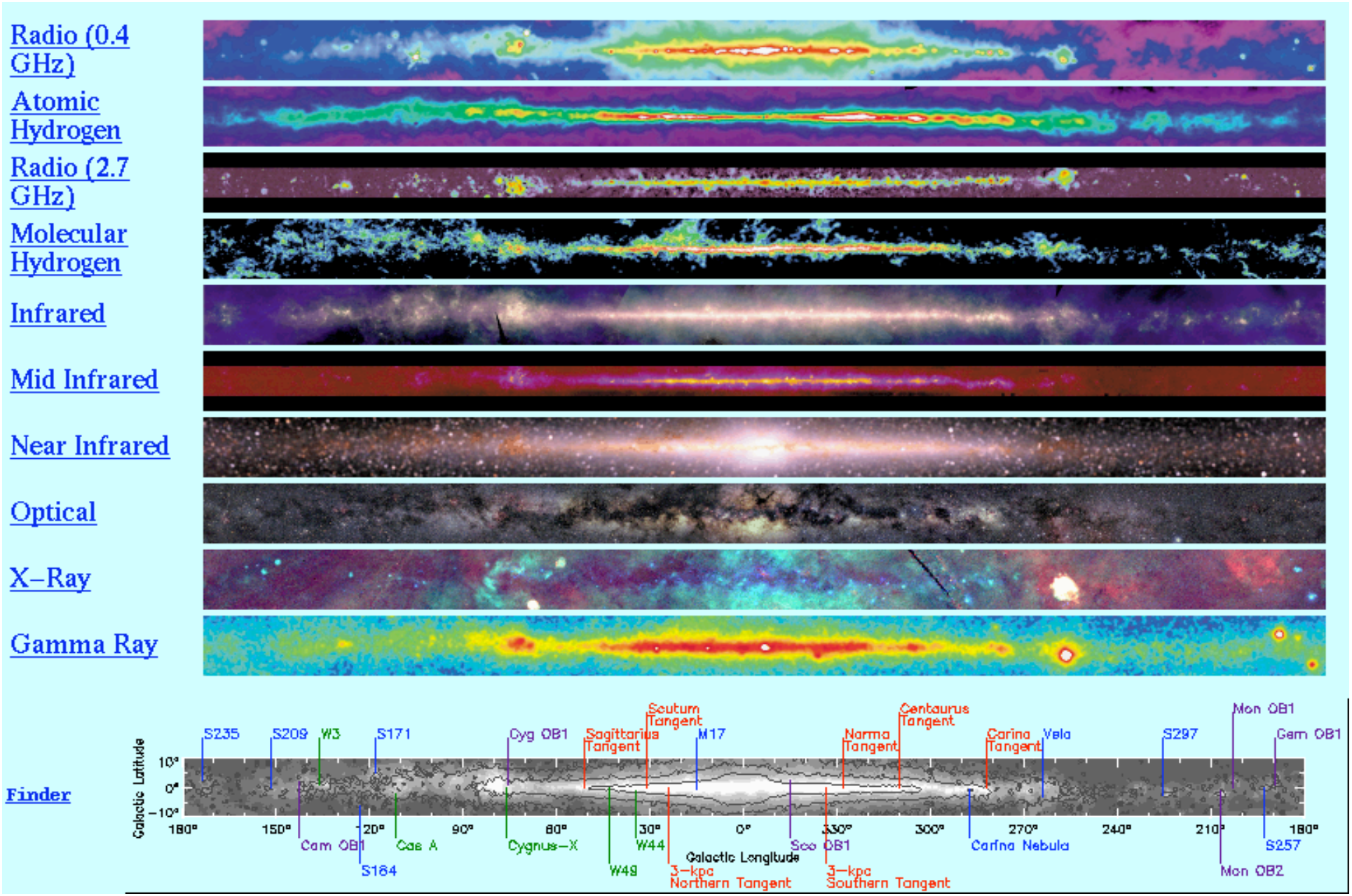
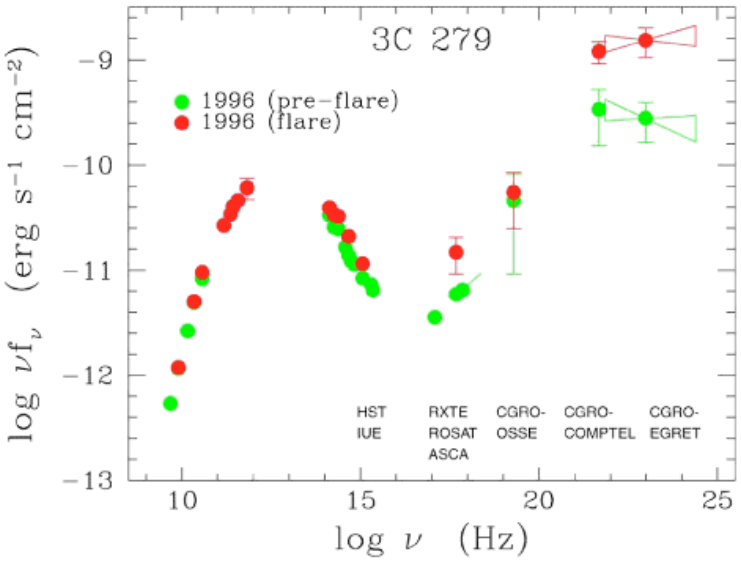
The "What, Where, and How" of multi-λ data

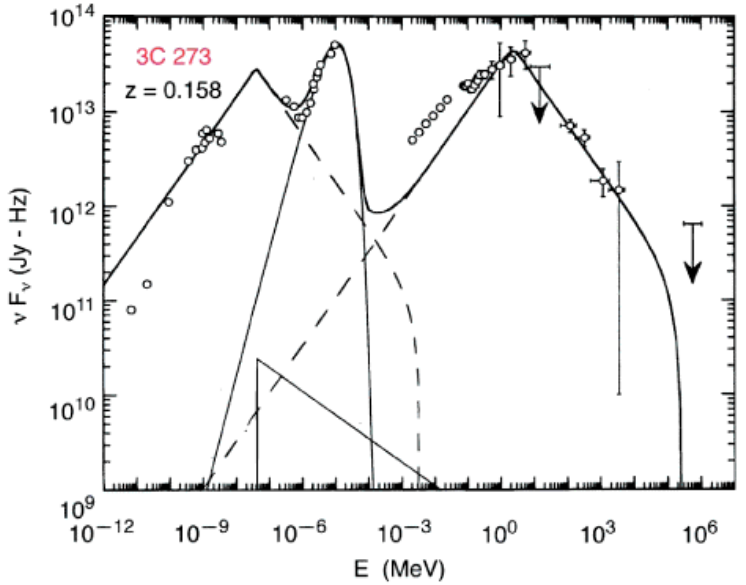
- The (obvious) need for multi-wavelength astronomical data
- Overview of available archives, surveys, and catalogues
- The Virtual Observatory

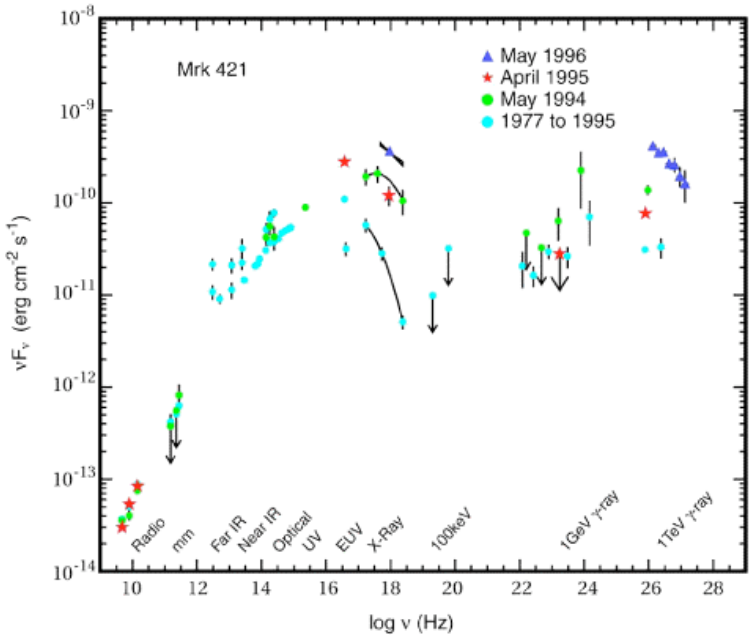
The Milky Way

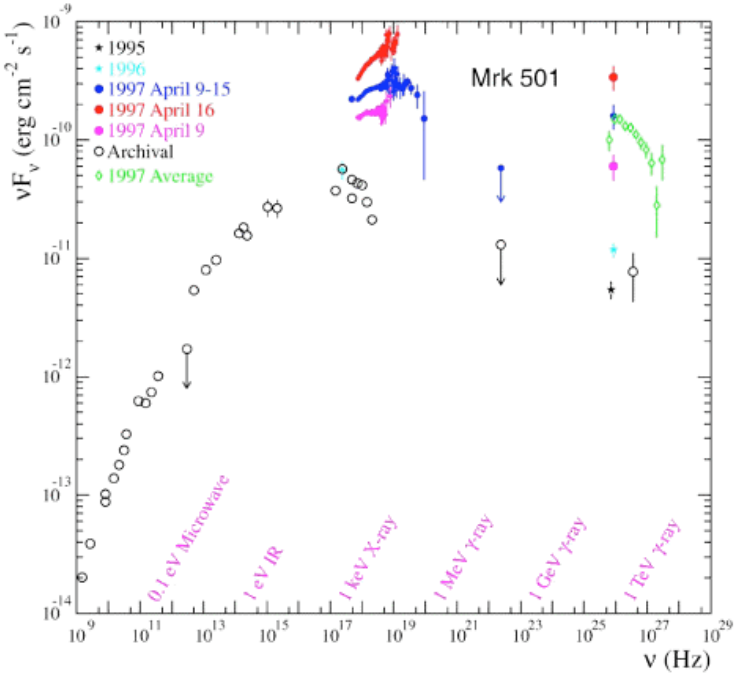


Active Galactic Nuclei



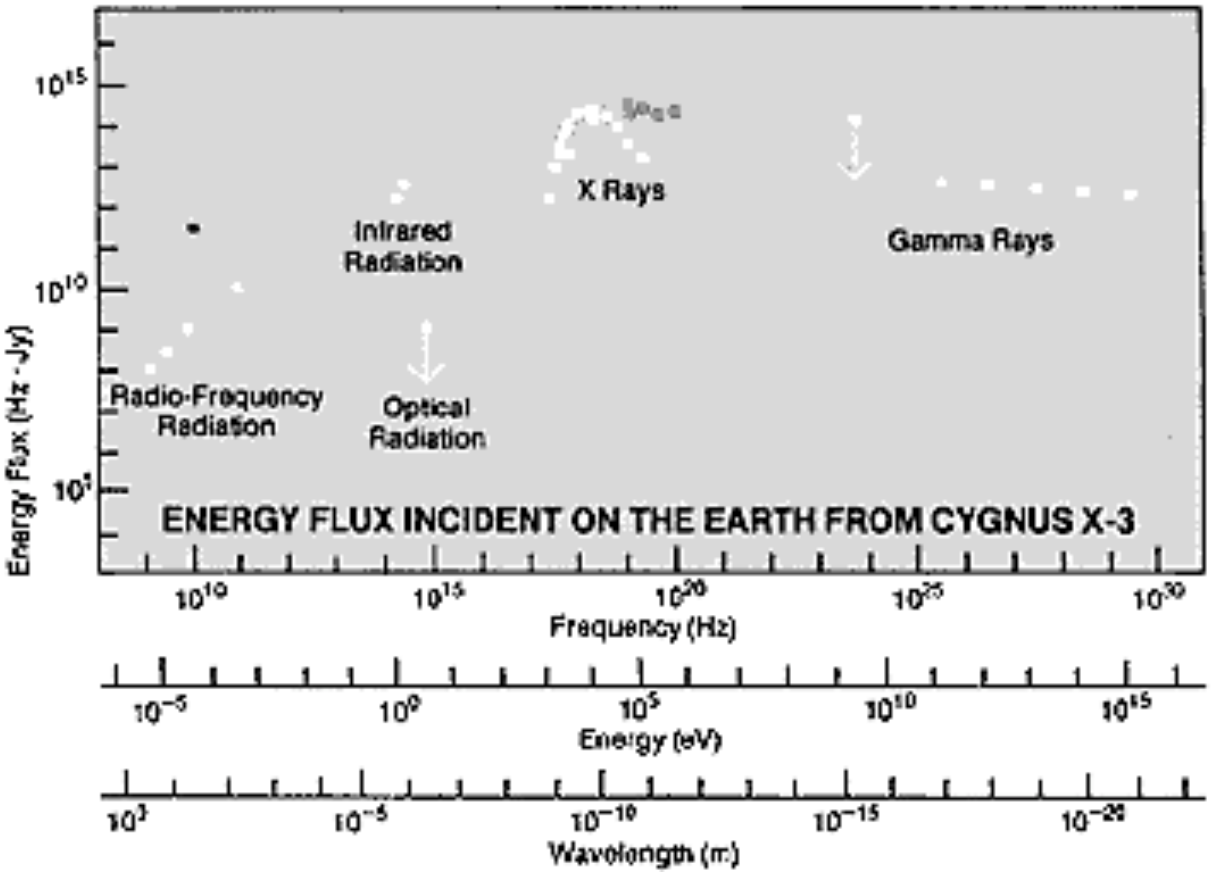






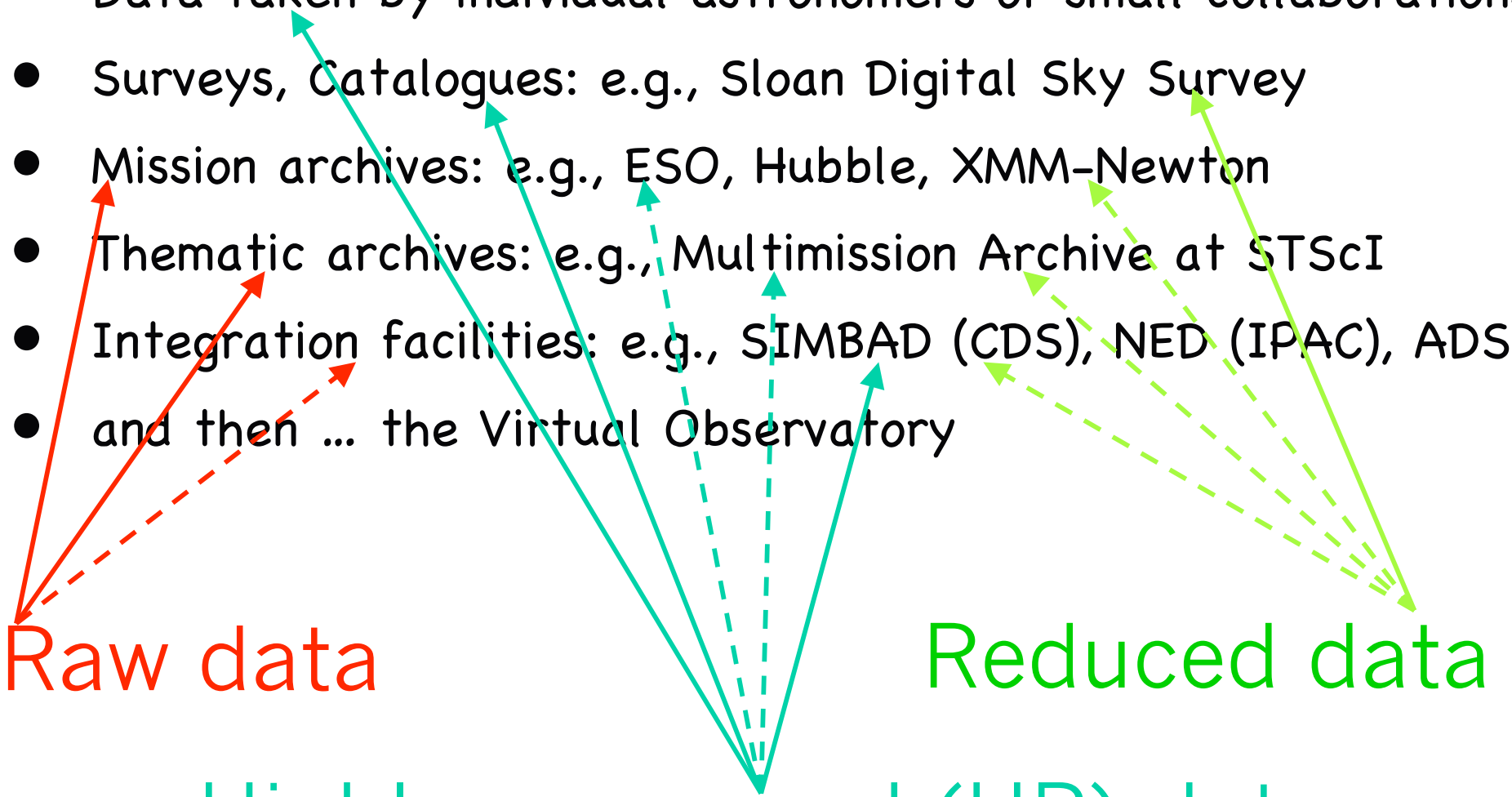
Stars

Cygnus X3



What is out there?

- Data taken by individual astronomers or small collaborations
- Surveys, Catalogues: e.g., Sloan Digital Sky Survey
- Mission archives: e.g., ESO, Hubble, XMM-Newton
- Thematic archives: e.g., Multimission Archive at STScI
- Integration facilities: e.g., SIMBAD (CDS), NED (IPAC), ADS
- and then … the Virtual Observatory



What is out there?

- Mission and thematic archives

  Always raw, sometimes reduced, rarely (getting better) HP data

- Integration facilities, Surveys & Catalogs, individual astronomers or small collaborations (which sometimes find their way back into the archives: c.f. ESO)

  Always HP data (and reduced and raw)

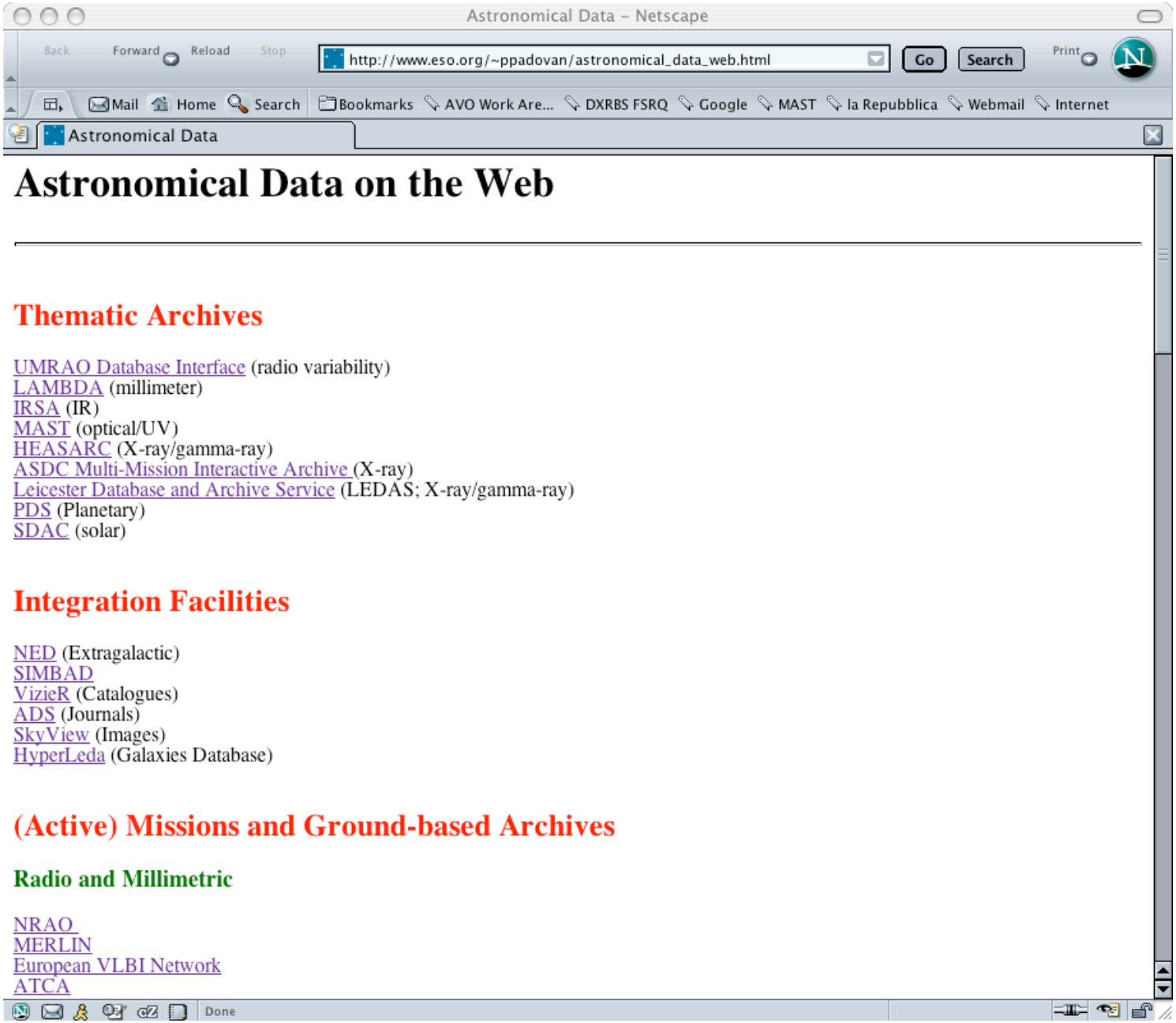
- Virtual Observatory

  Needs HP data to work at its best

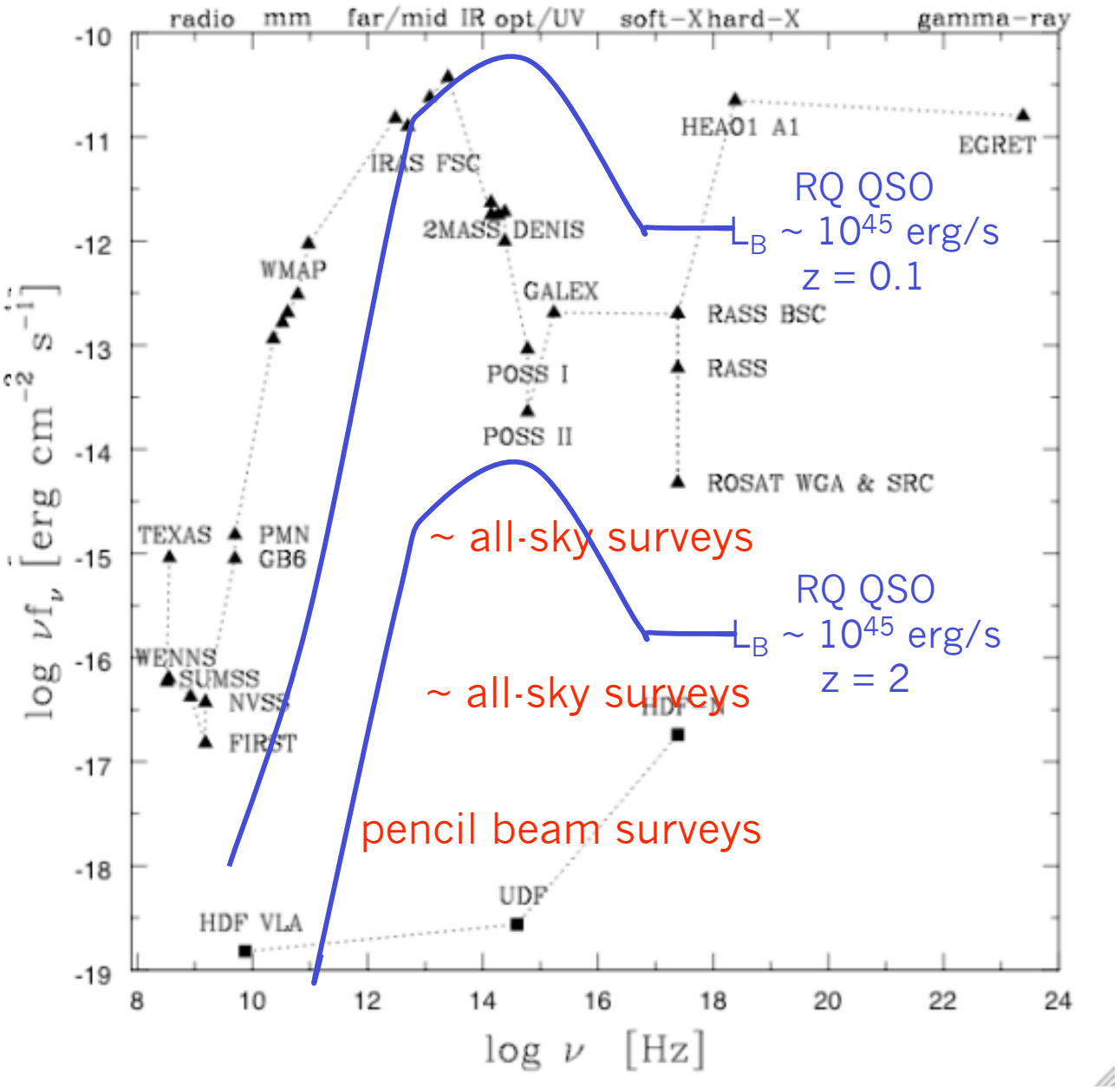
The Virtual Observatory

- An innovative, evolving system, which takes advantage of astronomical data explosion
- It will allow users to interrogate multiple data centres in a seamless and transparent way and to utilize at best astronomical data
- Data analysis tools (in-situ) and models will be made more accessible
- It will allow new SCIENCE by moving Astronomy beyond era of "classical" identification by combining all available information: data mining (increase obs. efficiency) + statistical identification (less need for spectra)
- Good communication ⇒ common language! Definition and adoption of VO standards and protocols within the International Virtual Observatory Alliance (IVOA: http://ivoa.net)
- At ESO: Virtual Observatory Systems Department, established Nov. 2004

Where?


Astronomical Data - Netscape
Back
Forward
Reload
Stop
http://www.eso.org/~ppadovan/astronomical_data_web.html
Go
Search
Print
Mail
Home
Search
Bookmarks
AVO Work Are...
DXRBS FSRQ
Google
MAST
la Repubblica
Webmail
Internet
Astronomical Data
Astronomical Data on the Web
Thematic Archives
UMRAO Database Interface (radio variability)
LAMBDA (millimeter)
IRSA (IR)
MAST (optical/UV)
HEASARC (X-ray/gamma-ray)
ASDC Multi-Mission Interactive Archive (X-ray)
Leicester Database and Archive Service (LEDAS; X-ray/gamma-ray)
PDS (Planetary)
SDAC (solar)
Integration Facilities
NED (Extragalactic)
SIMBAD
VizieR (Catalogues)
ADS (Journals)
SkyView (Images)
HyperLeda (Galaxies Database)
(Active) Missions and Ground-based Archives
Radio and Millimetric
NRAO
MERLIN
European VLBI Network
ATCA
Done

The Big Picture



How? 1. Individual Sources

- Q.: "find me ALL types of data at ALL wavelengths for my source or position" ⇒ ideal tool still does not exist but VO is getting close
- Can (almost) be done by wavelength: most thematic archives allow quick searches of **all** their holdings based on name and/or position (e.g., MAST, HEASARC, ESO/ST-ECF). Otherwise, all data providers allow this search (but clearly very time-consuming!)
- VO search tools:
  - ✓ DataScope: http://heasarc.gsfc.nasa.gov/cgi-bin/vo/datascope/init.pl
  - ✓ AstroScope: http://wiki.astrogrid.org/bin/view/Astrogrid/AstroScope
  - ✓ Aladin ("all VO")
- Published data only: NED or ADS ADS
  Can in most cases link back to the original data (e.g., ESO/ST-ECF, MAST, ISO, XMM, HEASARC, etc.)

How? 2. List of Sources

- Q.: "find me ALL types of data at ALL wavelengths for ALL my sources" ⇒ ideal tool still does not exist (even more so than for individual targets); VO could easily implement it
- A few data providers allow searches of their holdings based on a list of sources: MAST, HEASARC, ESO/ST-ECF, ISO, XMM, SIMBAD ESO Archive
- General search tools:
  - ✓ W3Browse (many services at once, X-ray bias): http://heasarc.gsfc.nasa.gov/db-perl/W3Browse/w3browse.pl W3
  - ✓ Aladin (one catalogue at a time but more general)
- Published data only: NED (batch job), ADS: not ideal

How? 3. Classes of Sources

- Q.: "find me ALL types of data at ALL wavelengths for ALL sources belonging to a given class" ⇒ dream on! Perfect VO tool
- Most data providers do not store classification information for their targets (exception: IUE archive). Problem would remain anyway for serendipitous sources.
- Some indirect ways exist; for example:
  - ✓ use MAST - VizieR cross-correlation tool: limited but direct http://archive.stsci.edu/vizier.php MAST
  - ✓ use NED's advanced all-sky search: powerful, but 1. requires second step 2. extragalactic only 3. still limited choice of classes
    http://nedwww.ipac.caltech.edu/forms/byparams.html NED
- That's all there is ... lots of space for improvement (VO)

Summary

- Plenty out there!
- Hopefully now you know more about where and how to find multi-λ data (and are ready to use them and publish great papers!)
- Archival data represent a goldmine, which is there waiting to be exploited; the availability of "highly processed" data will facilitate their usage
- Ideal tools to access multi-λ data are not there yet, but we are getting close
- For more on VO tools see http://www.euro-vo.org EURO-VO